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IbeX
Wavelength Dispersive Spectrometer

MAXray
Parallel Beam Spectrometer

IbeX/MAXray User's Guide

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Patents:

This product may be protected by one or more of the following US patents: 5926522
Other patents may be pending. Foreign patents may apply.

Revision history

Revision	Revision date	Principal changes	Software version
A	February 1999	Initial publication.	IbeX 2.0.5
B	February 2000	Incorporated MAXray and IbeX.	WDS 3.1.0
C	December 2003	Incorporates software changes.	WDS 3.1.6

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1 – Precautions and Safety Summary

Safety Precautions

Labels and documentation for the IbeX/MAXray indicate safety precautions as a WARNING or CAUTION. WARNING is used when the hazard or unsafe practice could result in severe injury or death. CAUTION is used when the hazard or unsafe practice could result in minor injury or property damage. Other recommendations for product use are marked as IMPORTANT or NOTE.

Your Thermo Electron equipment has been designed and tested to meet strict safety requirements. These include many safety agencies' examinations and approvals, as well as any compliance to established environmental standards. Heed the following precautions to ensure the continued safe operation of this equipment.

AC Power

WARNING: All electrical equipment must meet applicable codes and be installed by Thermo Electron authorized support representatives.

WARNING: Dangerous voltages are present inside the equipment.

High operating voltages are present inside the equipment. These voltages can produce severe burns or fatal electrical shocks.

- Failures in improperly grounded equipment can transfer dangerous voltages to outside surfaces.
- Numerous internal components operate at high voltages and may not be insulated or shielded.
- Components such as capacitors and batteries can store high voltages even with the power disconnected.

WARNING: Maintain proper equipment grounding.

- Always connect equipment to a properly grounded power source receptacle. If in doubt, have the receptacle checked by a qualified technician.
- Never use a ground adapter plug to connect Thermo Electron equipment to a power source receptacle that lacks ground connection terminals.
- Never operate your Thermo Electron equipment if you notice unusual noises or foul odors. Disconnect the power cord from the main power source and call your local Thermo Electron support specialist.

WARNING: Avoid contact with internal high voltage sources.

- Never remove any outer covers or guards that are fastened with screws without being so instructed either by this manual, or by a qualified Thermo Electron support specialist.
- Never attempt internal service or system adjustments unless instructed to do so either by this manual, or by a qualified Thermo Electron support specialist.
- Never remove system connections when power is applied.
- Never override or “cheat” electrical or mechanical interlock devices.
- When working around high voltage sources, be sure all power inputs are disconnected.
- When working around capacitors, batteries, and other power sources, allow a few minutes for capacitors to discharge after power has been removed.
- Avoid contact, direct or through metal tools or jewelry, with any uninsulated, internal, electrical component without being so instructed either by this manual, or by a qualified Thermo Electron support specialist.

Caution: The fuse in the power entry module must match the line voltage.

P-10 Gas

The flow proportional counter requires a special gas called P-10. Tanks of P-10 gas are available from local bottled gas suppliers. The tank of P-10 should have a two-stage regulator with a 1/4 NPT fitting to accept the Thermo Electron-supplied third stage regulator.

WARNING: P-10 gas is a HAZARDOUS MATERIAL. Handle P-10 gas in accordance with the manufacturer's Material Safety Data Sheet.

WARNING: Fasten the tank of P-10 gas securely to a fixed object, such as a wall or workbench, to avoid damage to the tank. The tank contains hazardous material under pressure. The tank is dangerous if its valve is damaged or the tank is punctured. However, the gas is *not* flammable.

IbeX/MAXray Spectrometer

Caution: Be sure the spectrometer working distance is correct.

WD spectrometers are designed to be used at a specific working distance from the sample. Consult your microscope manual for the recommended working distance for your equipment.

Caution: A high voltage cable connects the PCS box to the WD spectrometer. Do not disconnect this cable unless the entire system is powered off.

Caution: Setting the bias voltage for the detector too high could shorten the life of the detector. Use the bias scan to determine the proper voltage.

Caution: Initialize the spectrometer properly to avoid moving it beyond a hard limit.

Caution: The IbeX/MAXray spectrometer should not come into contact with any other microscope accessory except for those required by Thermo Electron Corporation.

Caution: Do not touch the spectrometer flow proportional counter window or the diffractors except as specified in the mounting procedures.

Caution: Do not touch the internal parts of the spectrometer with your hands, or oils from the skin surface could contaminate the spectrometer and increase pump-down time.

Caution: Do not scratch the O-ring mating surfaces on the spectrometer or interface flanges.

Caution: Do not place any magnetic media, such as floppy disks, near the magnets from the spectrometer electron trap. The magnets are very strong and could damage the media.

Caution: Do not change any of the IbeX/MAXray adjustment screws without the help of an authorized Thermo Electron Service engineer.

Diffractors

Caution: Do not touch the face of the diffractors.

Caution: Do not touch or attempt to clean the surface of any diffracting crystal.

The diffractor surfaces are sensitive and some can be dissolved with cleaning solvents, including water.

Manual Gate Valve Option

Never pump the column down with the gate valve closed and the spectrometer at atmosphere.

WARNING: Do not open the gate valve when the SEM is at vacuum and the WD spectrometer is at air.

Opening the gate valve under these conditions could expose the microscope vacuum system to contamination. If the filament is powered on, it may also be damaged.

WD Spectrometer Controller

WARNING: All electrical equipment must meet applicable codes and must be installed by Thermo Electron authorized support representatives.

WARNING: Dangerous voltages are present inside the equipment.

High operating voltages are present inside the equipment. These voltages can produce burns or fatal electrical shocks. Numerous internal components operate at high voltages and may not be insulated or shielded.

Components such as capacitors can store high voltages even with the power disconnected. When you are working around high voltage sources, be sure all power inputs are disconnected.

Never remove any outer covers or guards that are fastened with screws without being instructed by this manual or by a qualified Thermo Electron support specialist.

Never attempt internal service or system adjustments unless instructed to do so either by this manual or by a qualified Thermo Electron support specialist.

Maintain proper equipment grounding.

Always connect equipment to a properly grounded power source receptacle. If in doubt, have the receptacle checked by a qualified technician.

Never use a ground adapter plug to connect Thermo Electron equipment to a power source receptacle that lacks ground connection terminals.

Caution: Do not move the stage when the IbeX/MAXray optic is inserted without knowing its position. Driving the stage into the optic will damage the optic.

Caution: The controller must be installed according to the procedures described in the installation and service manual to avoid damage to the spectrometer.

Caution: The fuse(s) in the controller must match the line voltage.

Caution: Check that the fuse(s) for the input AC voltage are correct.

The switching power supply has a universal input autoranger that eliminates the requirement of changing jumper wires or switches to change the input voltage range, but the correct fuse(s) must be installed.

- For 100/120 VAC operation use one T 250V 3A fuse.
- For 230/240 VAC operation use two T 250V 2A fuses (5x20 mm).

Caution: For continued protection against fire, replace the fuse(s) only with the specified type.

Caution: Do not place objects under or around the bottom of the controller that would restrict the cabinet cooling.

Never operate your Thermo Electron equipment if you notice unusual noises or foul odors. Disconnect the power cord from the main power source and call your local Thermo Electron support specialist.

Caution: Make sure the P-10 gas flow through the proportional counter is correct before energizing the detector.

Flow Proportional Counter Window

The material that isolates the gas inside the detector from the vacuum of the spectrometer and the SEM chambers is made of polypropylene. If the window must be replaced, follow these precautions:

Caution: Shut off the high voltage to the detector.

Caution: Turn off the P-10 gas.

Caution: Solvents must not come into contact with the window.

WARNING: Do not seal off the gas flow routinely or the window will break.

Motorized Retraction and Manual Retraction

Do not change the retraction limits set during installation.

SEM Venting and Window Protection

Always loosen an unused port cover before venting the SEM. Air or nitrogen entering the chamber can easily break the proportional counter window.

Vorsichts- und Sicherheitsanweisungen

Aufschriften und Dokumente für den IbeX/MAXray unterteilten Vorsichts-maßnahmen in WARNUNG und VORSICHT. WARNUNG wird gebraucht, wenn eine gefährliche oder unsichere Benutzung in schwersten oder tödlichen Verletzungen enden kann. VORSICHT wird gebraucht wenn eine gefährliche oder unsichere Benutzung in geringeren Verletzungen oder Sachbeschädigung enden kann. Andere Empfehlungen für den Gebrauch des Produkts werden mit WICHTIG oder NOTIZ angeführt.

Ihre Thermo Electron Maschinen sind entworfen und getestet um den strengsten Sicherheitsanforderungen zu entsprechen. Das beeinhaltet eine Serie von Tests durch verschiedene Agenturen sowie alle Anforderungen, um den höchsten Ansprüchen zur Umweltverträglichkeit gerecht zu werden. Beachten Sie die folgenden Vorsichtsmaßnahmen um eine sichere Bedienung der Maschinen zu gewährleisten.

Wechselstrom / Elektrizität

WARNING: Alle elektrischen Maschinen müssen über anwendbare Codes verfügen und dürfen nur von Thermo Electron Fachpersonal oder beauftragtem Fachpersonal installiert werden.

WARNING: Im Inneren der Maschine befinden sich lebensgefährliche Spannungen.

Hohe elektrische Spannungen befinden sich im inneren der Maschine. Diese Spannungen können schwerste Verbrennungen oder tödliche Elektroschocks auslösen.

- Fehler mit nicht korrekt geerdeten Maschinene können hohe Spannungen an die Oberfläche transportieren.
- Verschiedene innere Komponenten arbeiten mit hohen Spannungen und dürfen weder isoliert noch abgedeckt werden.
- Komponenten wie Kondensatoren oder Batterien können hohe Spannungen beinhalten, auch wenn die Stromzufuhr unterbrochen ist.

Sorgen Sie dafür, daß die Maschinen korrekt geerdet sind.

- Schließen Sie die Maschinen nur an korrekt geerdete Steckdosen an. Wenn Sie unsicher sind, lassen Sie die Steckdose von einem Fachmann untersuchen.
- Schließen sie niemals Maschinen von Thermo Electron an nicht korrekt geerdete Steckdosen an.
- Arbeiten Sie niemals mit Maschinen von Thermo Electron, wenn Sie beim Betrieb merkwürdige Geräusche oder Gerüche wahrnehmen. Unterbrechen Sie die Stromversorgung und rufen Sie ihren örtliche Thermo Electron Fachmann an.

Vermeiden Sie jeden Kontakt mit Maschinenteilen unter Hochstrom

- Entfernen Sie keine Abdeckungen oder Schutzbleche, die mit Schrauben befestigt sind, wenn Sie nicht durch diese Anweisung oder einen Spezialisten von Thermo Electron dazu aufgefordert werden.
- Versuchen Sie niemals Einstellungen oder Reperaturen an den Maschinen zu machen, wenn Sie nicht durch diese Anweisung oder einen Spezialisten von Thermo Electron dazu aufgefordert werden.
- Entfernen Sie keine Verbindungen zwischen den Systemen, wenn die Maschine unter Strom steht.
- Schließen Sie niemals elektrische oder mechanische Unterbrechungen kurz.
- Wenn Sie mit Teilen unter hohen Spannungen arbeiten, müssen Sie in jedem Fall vorher die Stromversorgung unterbrechen.
- Wenn Sie in der Nähe von Kondensatoren, Batterien oder anderen Quellen von Elektrizität arbeiten, warten Sie nach der Unterbrechung des Stromkreises einige Minuten, damit sich die Restspannung entladen kann.
- Vermeiden Sie jeden Kontakt, direkt oder durch Metallwerkzeuge oder Metallschmuck mit inneren, nicht isolierten Maschinen-teilen, wenn Sie nicht durch diese Anweisung oder einen Spezialisten von Thermo Electron dazu aufgefordert werden.

Caution: Die Sicherung im Elektrizitätsmodul muß der allgemeinen Stromspannung entsprechen.

P-10 Gas

Der Zähler, der den proportionalen Fluß mißt, benötigt ein spezielles Gas, P-10. P-10 Gasflaschen könnenbei Ihrem örtlichen Gashändler erworben werden. Die Gasflaschen sollten einen zweistufigen Regulator mit einem 1/4 NPT Anschluß haben, damit der von Thermo Electron mitgelieferte Regulator zur dritten Stufe angeschlossen werden kann.

WARNING: P-10 Gas ist GEFÄHRLICHES MATERIAL. Benutzen Sie P-10 Gas nur in Übereinstimmung mit den Sicherheitsanweisungen, die Sie vom Hersteller erhalten.

WARNING: Befestigen Sie die P-10 Gasflaschen an ein sicheres, stabiles Objekt, wie eine Wand oder Werkbank. Die Gasflaschen beinhalten gefährliches Material unter Druck. Falls das Ventil beschädigt wird, oder der Mantel der Flasche undicht wird, tritt eine gefährliche Situation ein.

IbeX/MAXray Spektrometer

Caution: Der Arbeitsabstand des Spektrometers muß korrekt sein.

WD Spektrometer sind entworfen und hergestellt um mit einem speziellen Arbeitsabstand zur Probe zu arbeiten. Lesen Sie in ihrer Gebrauchsanweisung zum Mikroskop nach, welcher Abstand für ihre Maschine empfohlen ist.

Caution: Ein Hochspannungskabel verbindet die PCS Box mit dem WD Spektrometer. Unterbrechen Sie diese Verbindung nicht, wenn zuvor nicht die Stromzufuhr unterbrochen ist.

Caution: Wenn die Vorspannung für die Anzeige zu hoch eingestellt wird, kann die Lebensdauer der Anzeige verkürzt werden.

Caution: Das Spektrometer muß sorgfältig eingearbeitet werden, damit es sich nicht auf zu hohe Limits zubewegt.

Caution: Das IbeX/MAXray Spektrometer sollte nicht mit Zubehör in Kontakt kommen, das nicht von Thermo Electron ist.

Caution: Berühren Sie das Fenster des Diffraktors oder des Zählers, der den Durchfluß misst, nicht anders als in den Installationsanweisungen vorgeschrieben.

Caution: Berühren Sie nicht die inneren Teile des Spektrometers mit ihren Händen, oder öl von der Oberfläche ihrer Hände könnte das Spektrometer verunreinigen und die Abflußzeit verlängern.

Caution: Verkratzen Sie nicht die O-Ringe der aufeinanderarbeitenden Oberflächen, oder die Flange an den Schnittstellen.

Caution: Bringen Sie keine magnetischen Informationsträger wie Kassetten oder Disketten in die Nähe des Magneten des Elektronenverschlusses des Spektrometers. Die Magneten sind sehr stark und können die Informationsträger beschädigen.

Diffraktoren

Caution: Berühren Sie nicht die gebogene Oberfläche der Diffraktoren.

Caution: Berühren Sie nicht oder versuchen Sie nicht die Oberfläche der Diffraktorenkristalle zu säubern.

Die Oberfläche der Diffraktoren ist empfindlich, und kann sich bei Kontakt mit Reinigungsflüssigkeiten wie Wasser auflösen.

Manuelle Bedienung des Sperrventils

WARNING: Pumpen Sie niemals die Säule herunter, wenn das Sperrventil geschlossen und das Spektrometer unter Druck ist.

Caution: öffnen Sie niemals das Sperrventil, wenn das SEM im Vakuum und das WD Spektrometer an der Luft ist.

Wenn man unter diesen Umständen das Sperrventil öffnet, riskiert man die Verschmutzung des Mikroskop - Vakuumsystems. Wenn dabei der Glühfaden unter Strom steht, kann dieser ebenso beschädigt werden.

WD Spektrometer Kontrolle und proportionales Zählsystem

WARNING: Alle elektrischen Maschinen müssen über anwendbare Codes verfügen und dürfen nur von Thermo Electron Fachpersonal oder beauftragtem Fachpersonal installiert werde.

WARNING: Im Inneren der Maschine befinden sich lebensgefährliche Spannungen.

Hohe elektrische Spannungen befinden sich im inneren der Maschine. Diese Spannungen können schwerste Verbrennungen oder tödliche Elektroschocks auslösen. Komponenten wie Kondensatoren oder Batterien können hohe Spannungen beinhalten, auch wenn die Stromzufuhr unterbrochen ist.

Wenn Sie mit Teilen unter hohen Spannungen arbeiten, müssen Sie in jedem Fall vorher die Stromversorgung unterbrechen.

Entfernen Sie keine Abdeckungen oder Schutzbleche, die mit Schrauben befestigt sind, wenn Sie nicht durch diese Anweisung oder einen Spezialisten von Thermo Electron dazu aufgefordert werden.

Versuchen Sie niemals Einstellungen oder Reperaturen an den Maschinen zu machen, wenn Sie nicht durch diese Anweisung oder einen Spezialisten von Thermo Electron dazu aufgefordert werden.

Sorgen Sie dafür, daß die Maschinen korrekt geerdet sind.

Schließen Sie die Maschinen nur an korrekt geerdete Steckdosen an. Wenn Sie unsicher sind, lassen Sie die Steckdose von einem Fachmann untersuchen.

Schließen sie niemals Maschinen von Thermo Electron an nicht korrekt geerdete Steckdosen an.

Caution: Die Kontrolle muß gemäß den Vorschriften installiert werden, wie sie in der Montageanleitung und in der Betriebsanweisung vorgeschrieben werden, um das Spektrometer nicht zu beschädigen.

Caution: Die Sicherung / die Sicherungen in der Kontrolle müssen der allgemeinen Spannung entsprechen.

Caution: Prüfen Sie nach, daß die Sicherungen für den Wechselstrom korrekt sind.

Das Wechselstromaggregat hat einen universellen Mechanismus, der es überflüssig macht Kabel oder Schalter anzubringen, um die Maschine den verschiedenen Stromspannungen anzupassen. Die Sicherung muß dennoch korrekt installiert sein.

- Für 100 / 120 VAC Betrieb brauchen Sie eine T 250V 3A Sicherung.
- Für 230 / 240 VAC Betrieb brauchen Sie zwei T 250V 2A Sicherungen (5x20 mm).

Caution: Um einen dauernden Feuerschutz zu gewährleisten, wechseln Sie die Sicherung nur mit den genannten Typen aus.

Caution: Legen oder stellen Sie niemals Objekte irgendwelcher Art, die eine Kühlung vermeiden könnten, unter oder um den Boden der Kontrolle.

Never operate your Thermo Electron equipment if you notice unusual noises or foul odors. Disconnect the power cord from the main power source and call your Thermo Electron support specialist.

Das Fenster des Zählers, der den proportionalen Fluß misst

Das Material, das das Gas im Inneren der Anzeige vom Vakuum des Spektrometers und der SEM Kammern isoliert, ist aus Polypropylen gemacht. Falls Sie das Fenster ersetzen müssen, halten Sie sich an diese Sicherheitsanweisungen:

Caution: Unterbrechen Sie die Stromzufuhr der Anzeige.

Caution: Drehen Sie das P-10 Gas ab.

Caution: Keine Lösungsmittel dürfen mit dem Fenster in Berührung kommen.

WARNING: Dichten Sie den Gasfluß nicht mechanisch ab, oder das Fenster bricht.

Manuelles oder motorgetriebenes Zurückziehen

Nehmen Sie keine Änderungen an den bei der Installation eingestellten Rückzugsbegrenzungen vor.

SEM-Lüftung und Schutz des Fensters

Öffnen Sie stets einen unbenutzten Anschluß, bevor Sie das SEM lüften. Wenn Luft oder Stickstoff in die Kammer dringen, kann das Fenster des proportionalen Zählers leicht zerbrechen.

2 – Using IbeX/MAXray

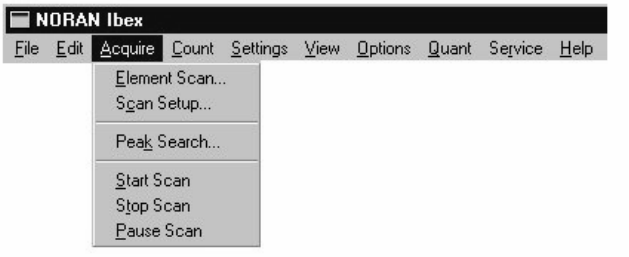
The IbeX/MAXray is designed to analyze one elemental x-ray line for each diffractor. Nearby lines are measured depending on the energy. Up to six diffractors are mounted on the turret. For more information on how the diffractors work see Theory of Operation, in this manuals appendix (A-1).

Software Controls and Layout

The following sections describe software operations such as mouse functions, access features, and terminology.

Menu Bar

The menu bar is at the top of the main window. The menus contain options for setting up, displaying, and operating the IbeX/MAXray software. Clicking once on a menu name displays the options.

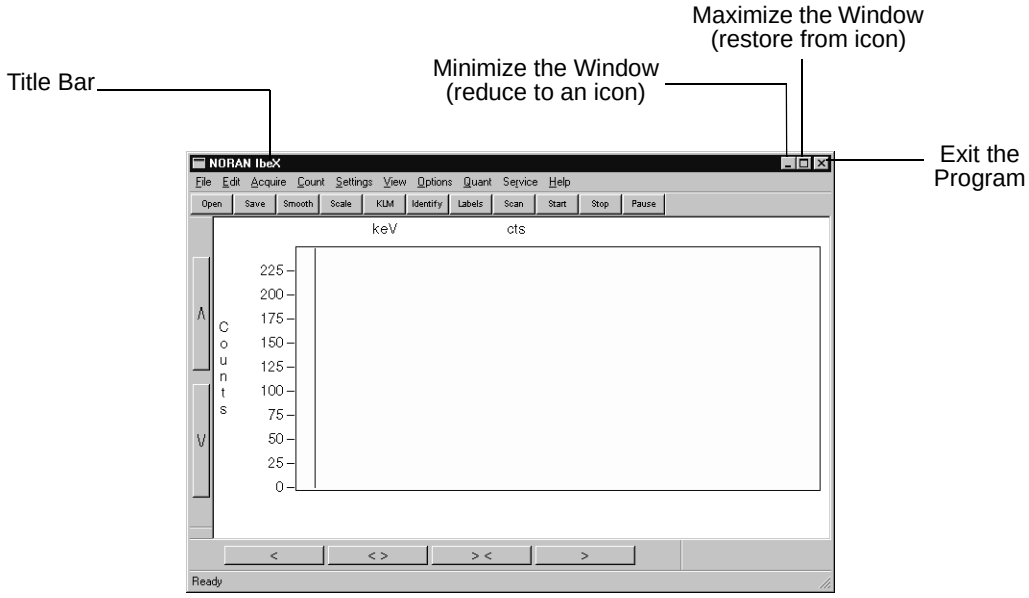


Toolbar

The toolbar is a row of shortcut buttons located below the menus. Each shortcut button corresponds to a menu option.

Microsoft Windows NT Tools

Most Windows applications display similar features and applications. The following diagram labels the window.



Active Window

Multiple windows can be displayed at the same time. However, only one window accepts commands. This windows is referred to as the active window. To activate a window click once on the window to activate. You can tell a window is active when the title bar is dark blue (or the customized Microsoft Windows setting). Inactive windows are grey.

Click and Drag

Most commands are preformed by clicking or double-clicking with your mouse. Clicking and dragging involves moving or positioning am object. For example moving a window to a new location on the desktop.

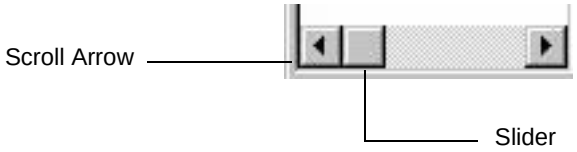
To click and drag an object left-click on an item, hold down the mouse button, and then move the object to the desired location. Use the click and drag technique to:

- Shift the spectrum (left or right) by clicking and dragging with the right mouse button.

- Shift the spectrums vertical scale by clicking and dragging with the right mouse button, up or down.
- Hold down both mouse buttons and drag left or right to scale (shrink or expand) the spectrum.

Scroll Bar

A scroll bar moves the display up, down, left, or right. To scroll quickly click and drag the slider. Click the scroll bar arrow to move slowly.

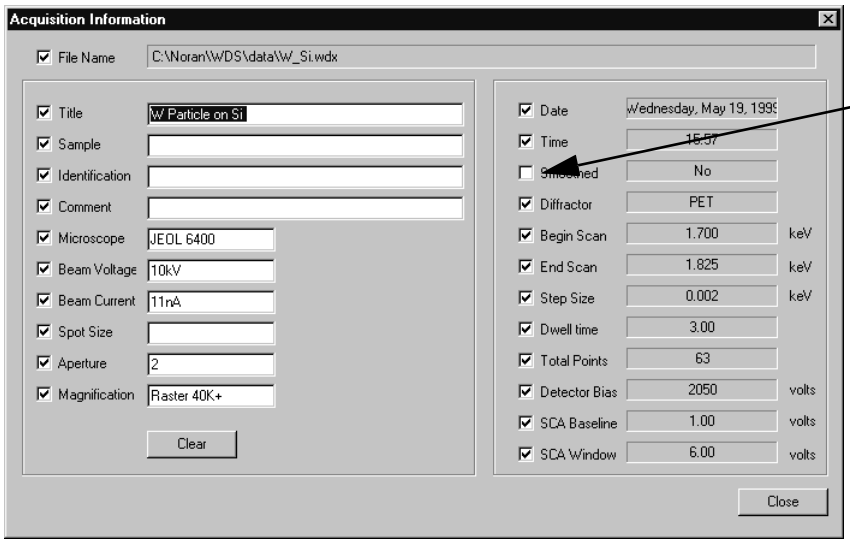


Drop-Down Box

A drop-down box contains an arrow that displays a list of available options. Click on the arrow button to display the list, and then select an option.

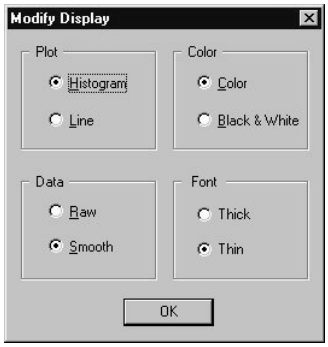
Check Boxes

Click a check box to choose the corresponding option, and check mark displays. Click on the check mark to remove the selection. The example below shows several check box options. Only one is not selected.



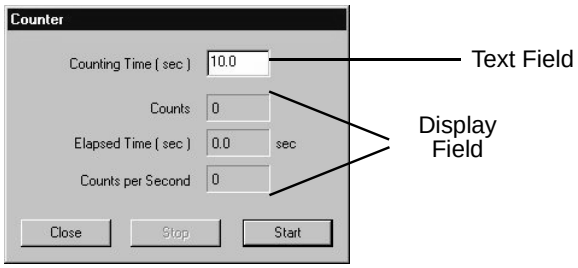
Option Buttons

Only one item can be selected from a set of option buttons. Click one option button and the other item(s) are no longer available. The example below shows 4 sets of option buttons. From each set only one options can be selected.



Text Fields

Text fields have a white background. Enter text by clicking inside the field, and then type the text. The example below shows one text fields. The remaining boxes display information that can not be changed, but varies depending on the system settings or variables set in a different area of the software.

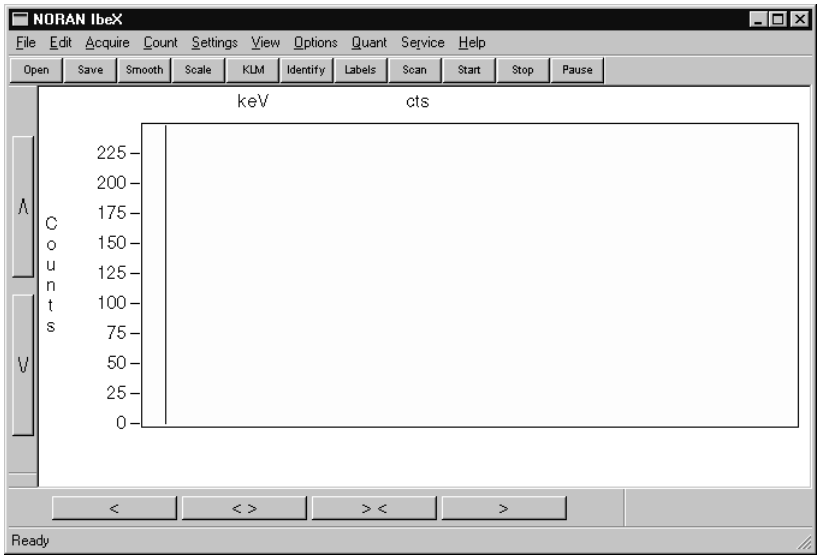


Starting IbeX/MAXray

Start the IbeX/MAXray software with the following procedure.

1. Click the Microsoft Windows **Start** button, select **Programs**, and then click **IbeX** or **MAXray**.

   The main IbeX/MAXray window displays.

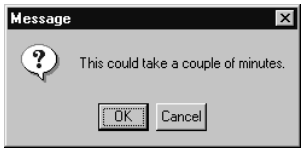


Initializing the System

Each time the IbeX/MAXray is turned off the diffractors and detector must be reset. Initialization takes approximately 3 minutes. For more information see Calibration Procedure.

1. From the **Service** menu, click **Initialize Motors**.

   A message dialog box displays.

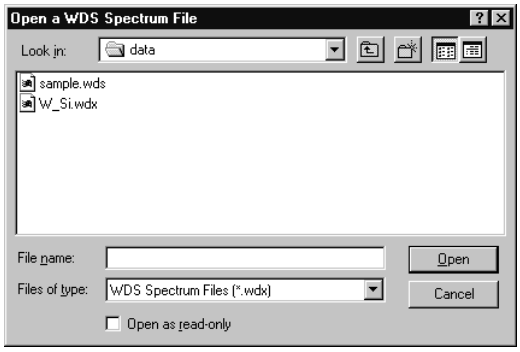


   - Click **OK** to initialize.
   - Click **Cancel** to exit without initializing.

Opening Files

IbeX/MAXray displays wds, wdx, or EMSA files. Files with the extension EMSA are accessed with the Open EMSA option (in the File menu). Open wds and wdx files with the following procedure.

1. From the **File** menu, click **Open**.



1. Select a file name.

   Double click on the file name to display. or change directories by clicking the **Look In** drop-down arrow. Thermo Electron provides example files in the directory C:\Noran\wds\data.

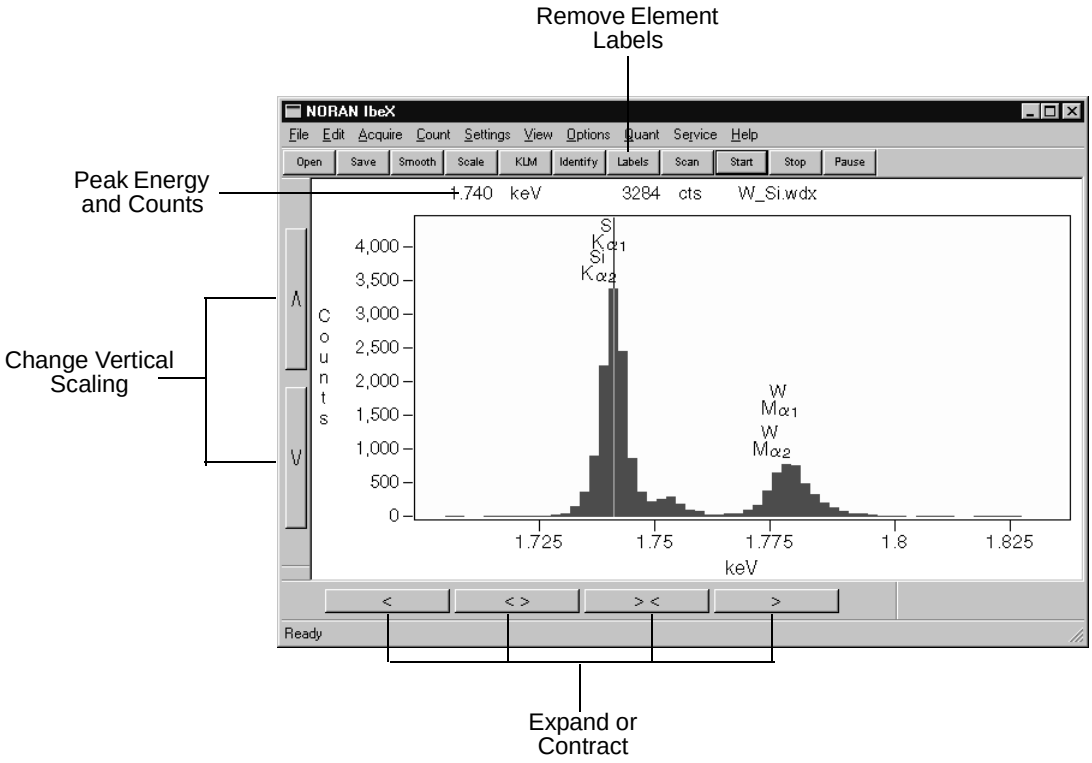
2. Open the file.

   Click **Open** to display the file.

Click **Cancel** to exit without opening a file.

Displaying a Spectrum

Several display options are available for viewing the spectrum. The diagram below labels the location of each control.



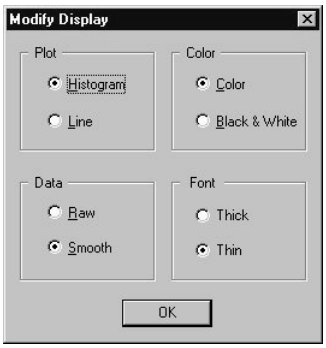
- Expand the spectrum – Click the **<** and **>** button.
- Contract the spectrum – Click the **>** and **<** button.
- Scroll left and right – Click the < and > button, or click and drag on the spectrum to move left or right, with the right mouse button.
- Vertically Scale the spectrum – Click the ∧ and ∨ buttons, or click and drag on the spectrum to move up and down, with the right mouse button.
- Move the arrow buttons to the desktop – Click and drag on the blank area around the arrow buttons. The arrow buttons are on a toolbar to provide additional display area.

- The IbeX/MAXray window shows the energy (keV) and number of counts at the cursor position. You can drag the cursor across the spectrum.

Display Options

Determine the information to view in the IbeX/MAXray window. Select from the following options.

1. From the **Options** menu, click **Modify Display**.



2. Select Display Options.

   Select one option from each section.

   - Plot – Display the spectrum as a **Histogram** or **Line**.
   - Color – Display the spectrum in **Color** or **Black & White**.
   - Data – Display the spectrum with **Raw** data or with **Smooth** (averaged) data.
   - Font – Display text in a **Thick** (bold) or **Thin** (regular) font.

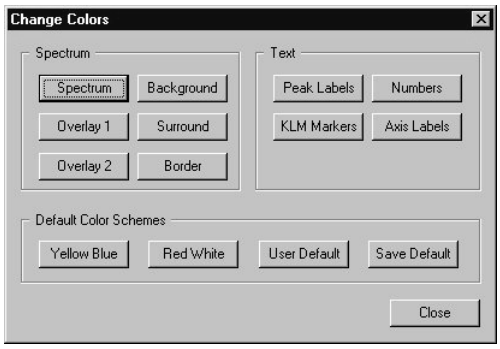
3. Exit Modify Display.

   Click **OK** to save the changes and exit.

Changing Display Colors

Customize the display and spectrum colors with the following procedure.

1. From the **Options** menu, click **Change Colors**.



2. Set the color scheme.

   Click an item button, and then select a color. Select from the following items or select a preset (default) color scheme.

   - Spectrum – The spectrum line or histogram.
   - Overlay 1 – The first overlay spectra.
   - Overlay 2 – The second overlay spectra.
   - Background – The color behind the spectrum.
   - Surround –The area surrounding the spectrum window.
   - Border – The area around the spectrum window.
   - Peak Labels – Display over the spectrum.
   - KLM Markers – The KLM markers.
   - Numbers – The vertical and horizontal scale (numbers and tic marks).
   - Axis Label – The axes labels.

   Default Color Schemes

   - Yellow Blue – A preset color scheme using yellow and blue.
   - Red White – A preset color scheme using red and white.
   - User Default – The defined default color scheme.

3. Apply the changes.

   Click **Close**.

Customizing the Default Color Scheme

The default color scheme is applies to all new files. Edit and apply the default color scheme with the following procedure.

1. Set color preferences.

   Select and set each parameter color, and then click **Save Default**.

2. Apply the default color scheme.

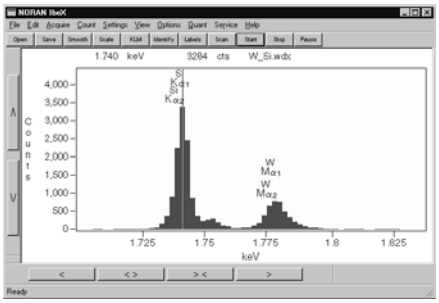
   Click **User Default** to apply the color scheme. The default color scheme is applied to the current file and all new files.

Smoothing Peaks

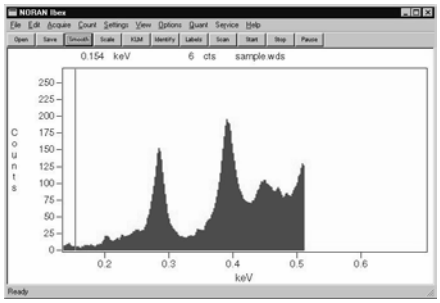
Spectral peaks may be easier to identify by using the Smooth feature.

1. From the **Options** menu, click **Smooth Spectrum**.

   To return to the display to raw data click the **Smooth** button on the toolbar.



Raw Spectral Data



Smoothing Applied

Labeling a Spectrum

The spectral peaks represent elements in the sample. Qualitative analysis measures the elements energy and relates it to elements in the periodic table. The energy intensities are an indication of elements in the sample. Example spectra files are available in the directory C:\Noran\wds\data. Identify spectral peaks using one of the following methods:

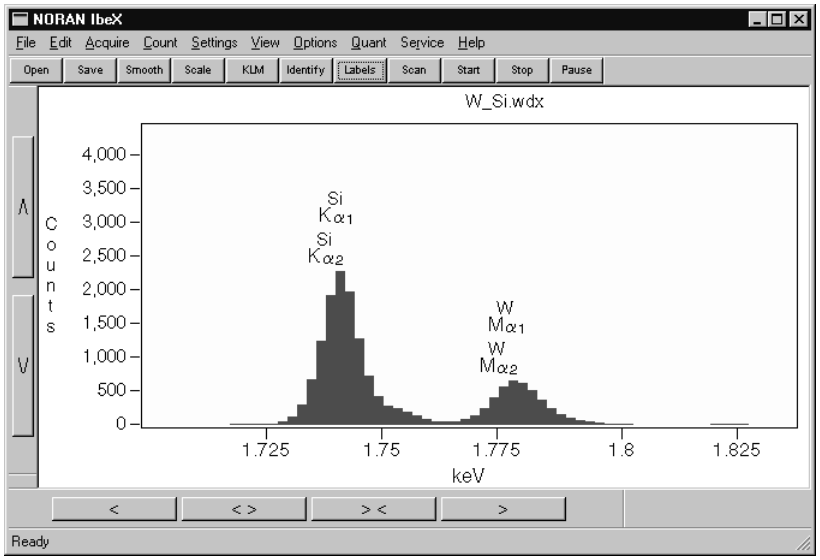
- Automatic – IbeX/MAXray identifies peaks (energy).
- Manual – You select and identify the elements.

Automatic

This method automatically identify the element peaks in the spectrum.

1. From the **Options** menu, Click **Identify Peaks**.

   Labels display for each element and x-ray line name Peaks are labeled by the atomic symbol and x-ray line name.



2. Remove the displayed labels.

   Click the **Labels** button on the toolbar.

Manual

To identify peaks manually some knowledge of spectral microanalysis is necessary. For more information read “Scanning Electron Microscopy and X-Ray Microanalysis: A Text for Biologists, Materials Scientists, and Geologists (2nd ed.)”, by Joseph I. Goldstein et al. (Chapters 6-8).

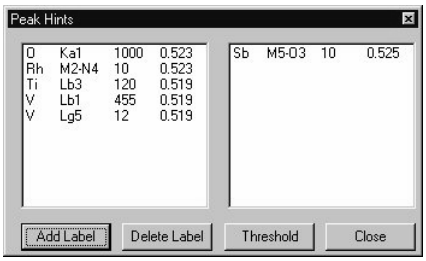
Peak Hints

For assistance in identifying peaks use the Peak Hints option.

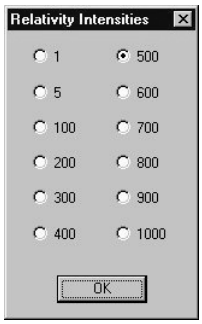
1. From the **Options** menu, click **Peak Hints.**

   The dialog boxes left-side displays peaks to the left of the cursor position. The dialog boxes right-side displays peaks to the right of the current cursor position.

To change the display labels move the cursor over the spectrum. Each peak is identified by the atomic symbol, x-ray line name, relative intensity (1000 highest probability of the peak existing, and energy (in keV).



2. Modify Peak Hints.
   - Add labels – Click once on an element, and then click **Add Label**.
   - Remove labels – Click once on an element, and then click **Delete Label**.
   - Display peaks with a minimum intensity (Threshold) – Display element lines with relative intensities above a defined threshold in the peak hints and peak identification. Click **Threshold**, select an intensity value, and then click **OK**.



3. Apply the changes to Peak Hints.

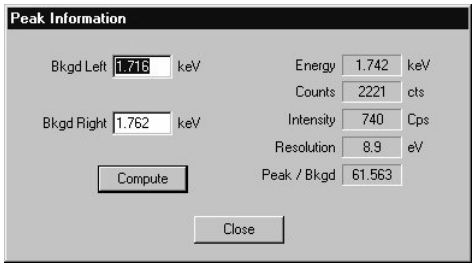
   Click **Close**.

Peak Information

Display information about the peak that the cursor is located on.

1. Move the cursor to a peak.
2. From the **View** menu, click **Cursor**. Place the cursor on the peak you wish to view information on by clicking once on the peak.

3. From the **View** menu, click **Peak Information**.



   The Background energy to the left and right of the selected peak displays in the Bkgd Right and Bkgd Right fields. The Energy, Counts, Intensity, Resolution, and Peak/Bkgr values display

4. Modify the peak information location (range).

   Enter a value for the **Bkgd Left** and **Bkgd Right**, and then click **Compute**. The peak information for the energy range displays.

5. Exit Peak Information.

   Click **Close**.

Displaying KLM Markers

Add KLM labels to the spectrum with the following procedure.

1. From the **View** menu, click **KLM Markers**.

2. Select an element to associates with the peak.

   Click the **Table** button. Click once on an element to associate with the current peak, and then click **OK**.

   The x-ray line and atomic symbol display at the peak.

   - To move through the periodic table one element at a time, click the up and down arrows on the KLM Markers toolbar.
   - The current element appears in the KLM Markers toolbar. If you have already applied a KLM marker to the current element in the spectrum (and if the label display is turned on), the marker appears on the spectrum.

   For more information on moving to a particular region of the spectrum see Displaying a Spectrum.

3. Modify the label display.
   - Add labels - Click **Add Label** to display the KLM marker on the spectrum.
   - Remove labels - Click once on the element, and then click **Delete Label**.

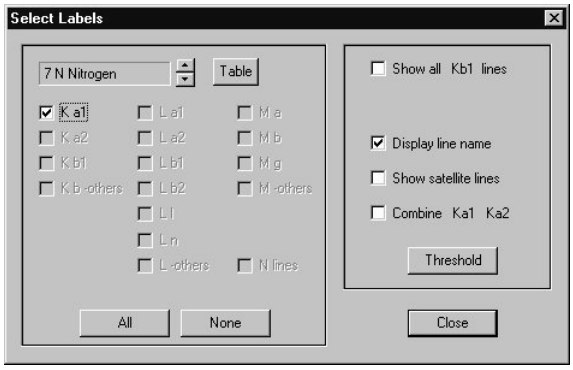
   If a combination of manual and automatic labels are used, and the KLM button is selected, the automatic labels disappear when the Labels button is selected.
4. Remove the KLM markers window.

   From the toolbar, click the **KLM Markers** button.

Selecting Labels

Create and display element labels on the spectrum.

1. From the **Options** menu, click **Select Labels**.



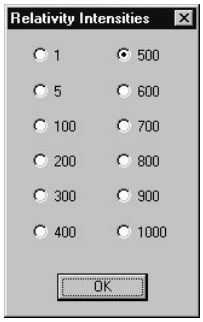
2. Select an element to label.

   Click **Table**. The periodic table of elements displays. Click once on an element.
3. Select the x-ray lines to display.
   - Click the check boxes of the x-ray lines to include on the display. The available x-ray lines depends on the selected element.
   - Click the **All** button to include all the available lines for the current element.
   - Click the **None** button to remove all lines for the current element.
4. Select addition label display options for the current element.
   - Display line name – The x-ray lines name.
   - Show satellite lines – The satellite lines.
   - Combine Ka1 and Ka2 – The Ka 1 and Ka2 lines are combined into one line labeled

KA. These lines are typically very close together.

5. Display x-ray lines according to Relative Intensity.

   Click the **Threshold** button.



   Select an intensity value, and then click **OK**. Peak intensities are shown on the y-axis of the spectrum. The label for any intensity peaks below the threshold are not displayed.

6. Apply the changes.

   Click **Close**.

Setting Up a Scan Acquisition

To collect data set up the microscope and sample, set the acquisition parameters, and then acquire the spectrum.

To re-acquire or review a previously saved spectrum load the saved file, and then edit as needed.

Microscope and Sample

Before preparing the microscope and sample read the safety precautions in Chapter 1.

1. Selecting a sample.

   Use a sample free of oils and particles to reduce the chance of contaminating or corroding the microscope chamber or detector. Well-polished (smooth) surface produces the best results. X-ray absorption varies when using a rough surface and reduces the accuracy of your results.

2. Insert the sample and evacuate the chamber.

   Do not bump the spectrometer with the sample or expose the spectrometer to a sudden changes in pressure.

Acquisitions are sensitive to sample position and angle.

3. Set the microscopes accelerating voltage.

   Set the accelerating voltage to at least 1-1/2 times the highest spectral peak.

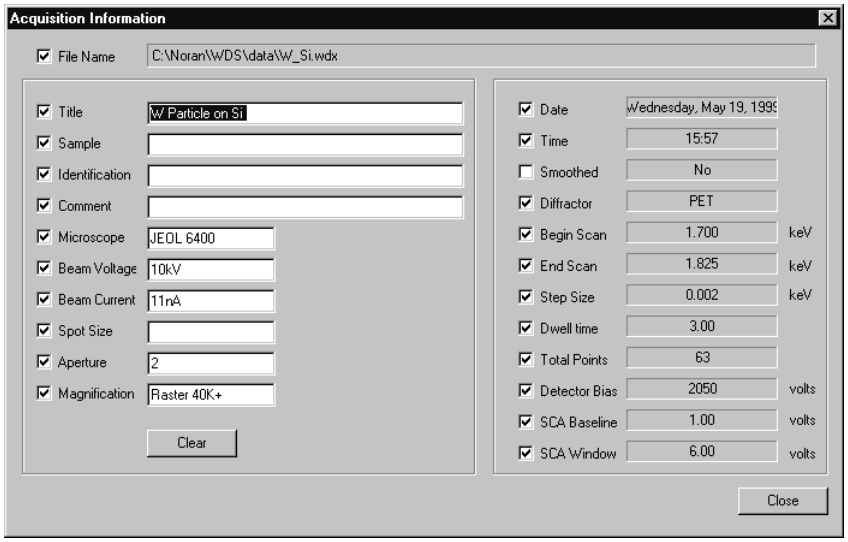
4. Obtain an image of the sample.

   A small scan area improve the most accurate results. Zoom-in to a higher magnification or select the Spot Mode on the microscope. Not all microscope are equipped with the spot mode feature. For more information see your microscopes user manual.

Acquisition Information

Acquisition information remains the same from scan to scan until it is modified and is saved with a file. The report content is selected in this window.

1. From the **Edit** menu, click **Acquisition Information**.



2. Enter the acquisition information.

   These settings must match the microscope. The remaining parameters display for printing purposed only.

   - File Name – The file name for the spectrum document.
   - Title – A detailed description of the file.
   - Sample – A short description of the sample.
   - Identification – Sample identification.

- Comment – Miscellaneous remarks about the sample or acquisition.
- Microscope – The microscope model.
- Beam Voltage – The voltage that produces the electron beam, in keV.
- Beam Current – The microscopes beam current, in nanoamps (nA).
- Spot Size – The electron beams spot size.
- Aperture – The aperture of the microscope objective.
- Magnification – The magnification value.

3. Select the information to print on the results report.

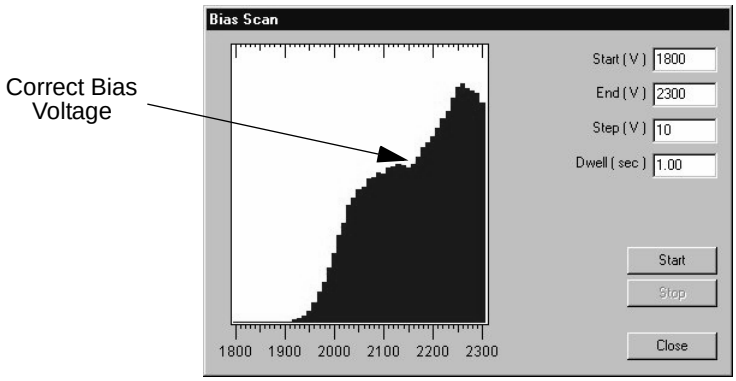
   Select the check boxes to include on the results report. For more information see Printing Reports.

4. Apply the changes to Acquisition Information.
   - Click **Close**.
   - Click **Clear** to delete all Acquisition Information.

Bias Scan

Determine the detectors bias voltage for an x-ray line.

1. Focus the microscope on the element of interest, and then position the spectrometer.
2. From the **Settings** menu, click **Bias Scan**.



3. Begin the Scan.

   Use the systems default settings. Click **Start**.

4. Center the correct bias voltage.

The correct bias voltage is above the first shoulder, and prior to the sharp peak. If this point is not visible or not centered on the display modify the starting voltage until the correct voltage is determined. The example above shows a centered voltage point.

- If the display is to far left – Increase the starting bias and decrease the ending bias, by the same amounts.
- If the display is to far right – Decrease the starting bias and increase the ending bias by the same amount.

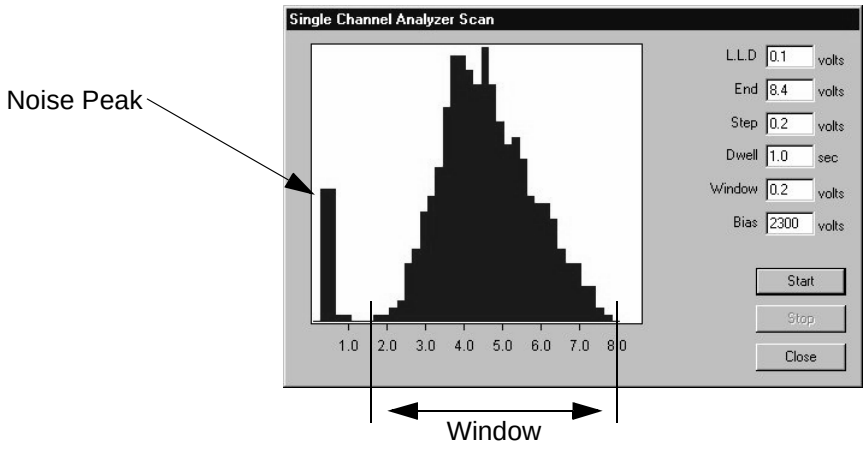
5. Exit Bias Scan.

   Click **Close**.

SCA Scan

A single channel analyzer (SCA) scan fine tunes the detector bias voltage (found with the Bias Scan function). The Detector Bias voltage, SCA Baseline voltage, and SCA Window voltage must be determined.

1. From the **Settings** menu, click **SCA Scan**.



2. Begin the scan.

   Enter the Bias voltage and Low Level Discriminator (LLD), and then click Start.

   - LLD – The voltage setting that prevents the noise peak from displaying.
   - Bias – The voltage determined during in the bias scan.
   - Use the system default settings for all other parameters.

3. Determine the correct SCA voltage.

- The **SCA baseline** occurs at the valley between the noise peak and the start signal peak.
- The **SCA Window** is the peaks width, from the baseline voltage to where the peak tails off.

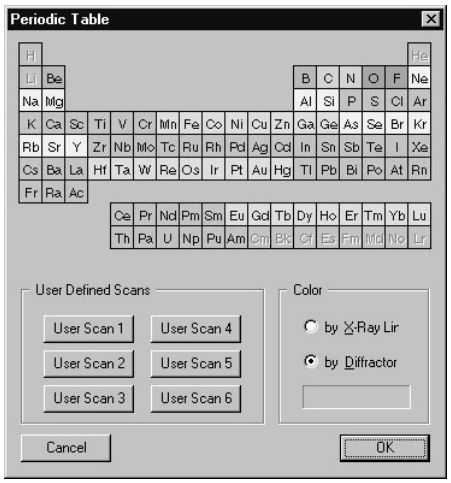
4. Exit Single Channel Analyzer Scan.

   Click **Close**.

Scanning for One Element

Scanning for a particular element with the

1. From the **Acquire** menu, click **Element Scan**.



2. Select an element.

   Click once on the element to scan or select one of the pre-set user scan buttons. For more information see Saving the Acquisition Setup.

3. Select a Color option.

   Select the color coding that the periodic table of elements

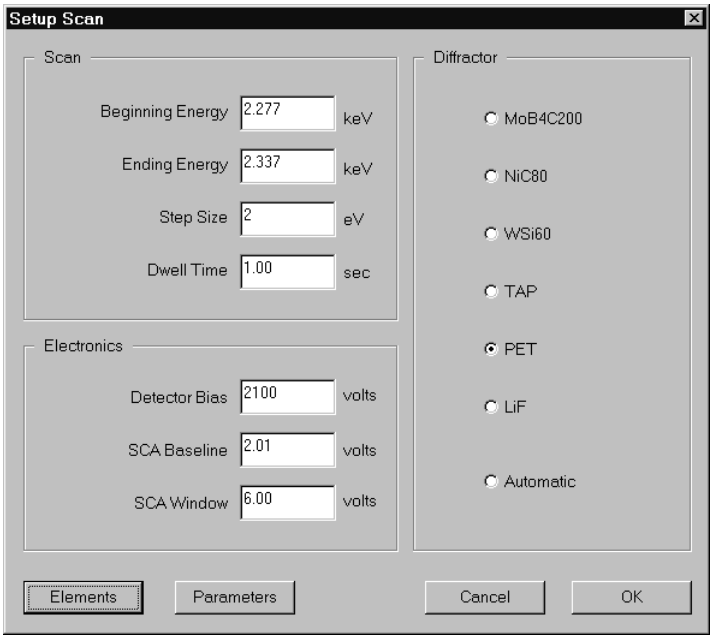
   - Select by **X-ray Line** to identify elements by energy lines.
   - Select by **Diffractor** to identify elements by the type of diffractor that is used to detect that element.

4. Exit Periodic Table.
   - Click **OK** to save the changes and exit.
   - Click **Cancel** to exit without saving the changes.

Scan Parameters

Before acquiring a spectrum verify the microscope settings and make any necessary adjustments.

1. From the **Acquire** menu, click **Setup Scan**.



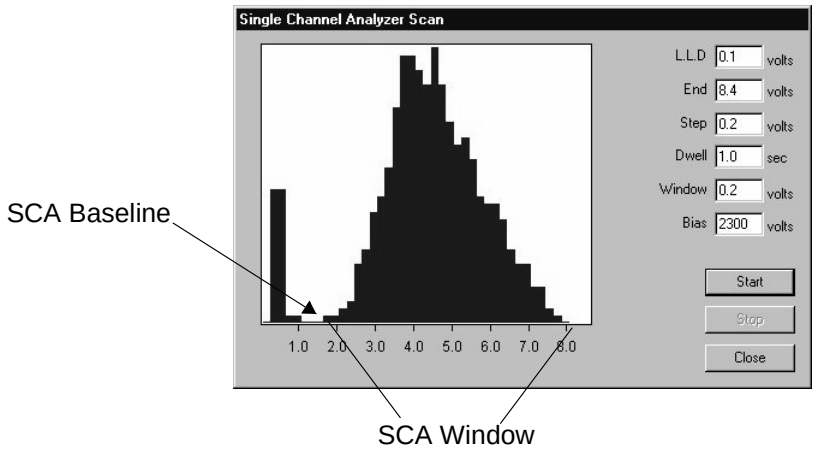
2. Enter Scan and Electronics settings.

   Click **Elements** and select an element from the periodic table of elements. The following settings are entered for the selected element. Make any necessary changes to these values.

   - Beginning Energy – The scans minimum energy level, in keV.
   - Ending Energy – The scans maximum energy level, in keV.
   - Step Size – The spectrometer step size during acquisition, in eV.
   - Dwell Time – The dwell time on each step of the scan, in seconds.
   - Detector Bias – The optimum detector voltage for the bias scan. For more information

see SCA Scan.

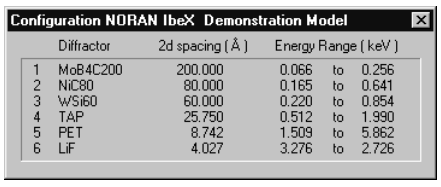
- SCA Baseline – The optimum detector baseline voltage for the SCA scan. Optimize this value to reduce noise. The sum of SCA Baseline and SCA Window must not exceed 8.4V. See diagram below.
- SCA Window – The optimum range of detection for the SCA scan, in volts. By optimizing this value, you can reject counts produced by noise. The sum of SCA Baseline and SCA Window must not exceed 8.4V. See diagram below.



3. Select a Diffractor.

   A diffractor within the Beginning Energy and Ending Energy field must be selected. The available diffractors vary from system to system.

   - From the **Settings** menu, click **Configuration**. A window listing the diffractors and corresponding energy ranges. Select a diffractor by its energy ranges.

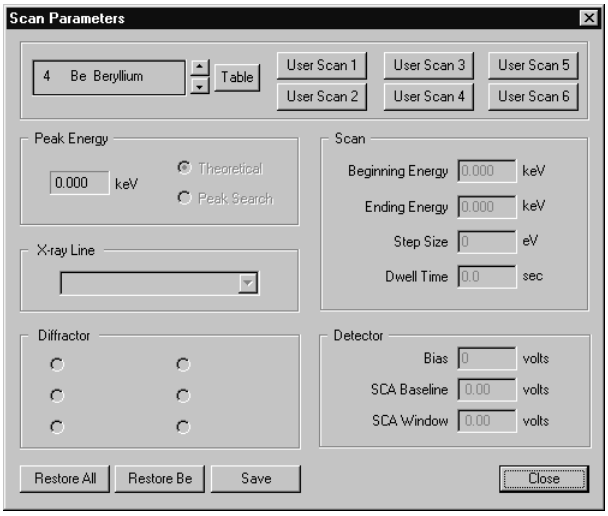


	Diffractor	2d spacing (Å)	Energy Range (keV)		
1	MoB4C200	200.000	0.066	to	0.256
2	NiC80	80.000	0.165	to	0.641
3	WSi60	60.000	0.220	to	0.854
4	TAP	25.750	0.512	to	1.990
5	PET	8.742	1.509	to	5.862
6	LiF	4.027	3.276	to	2.726

   - Select **Automatic** to have IbeX/MAXray select the best diffractor.

4. Select acquisition parameters for individual elements.

   Click the **Parameters** button. For more information see Saving the Acquisition Set Up.



5. Select an element.

   Click the up and down arrows to select an element, or click **Table** to select from a periodic table of elements.

6. Select the Peak Energy option.

   The selected energy (keV) displays when a select is made.

   - Select **Theoretical** to use the determined energy value.
   - Select **Peak Search** to use the energy value determined during the peak search. For more information see Peak Search.

7. Select the X-ray lines.

   Click the X-ray Lines drop down box to select the K, L, M, and N lines of interest.

8. Select a diffractor.

   Diffractor settings are passed to the Scan Setup Window. The diffractor options may vary from spectrometer to spectrometer.

9. Enter the elements scan parameters.

   - Beginning Energy - The scans minimum energy level, in keV.
   - Ending Energy - The scans maximum energy level, in keV.
   - Step Size – The spectrometer step size during acquisition, in eV.

- Dwell Time – The dwell time on each step, in seconds.
- Detector Bias – The optimum detector voltage for the scan range.
- SCA Baseline – The optimum detector baseline voltage for the SCA scan. By optimizing this value, you can reject counts produced by noise.
- SCA Window – The optimum range of detection for the SCA scan, in volts. By optimizing this value, you can reject counts produced by noise. The sum of SCA Baseline and SCA Window must not exceed 8.4V.

10. Save the defined parameters.
    - Click **Save** to save the set of parameters. Click **Yes** to confirm the save command.
    - Click **Restore All** to reset to the systems default settings. The bias settings and the element table are reset. Click **Yes** to confirm the reset all command. This resets all the scan parameters to default settings, only use this option in the case where most parameters need to be reset.
    - Click **Restore Be** (Beryllium) to reset the current element only. This buttons name changes each time the current element changes and only resets the current element.
11. Apply the changes to Scan Parameters.

    Click **Close**.

    Apply the changes to Setup Scan.

    Click **OK** to save the changes and exit.

    Click **Cancel** to exit without saving the changes.

Saving the Acquisition Set Up

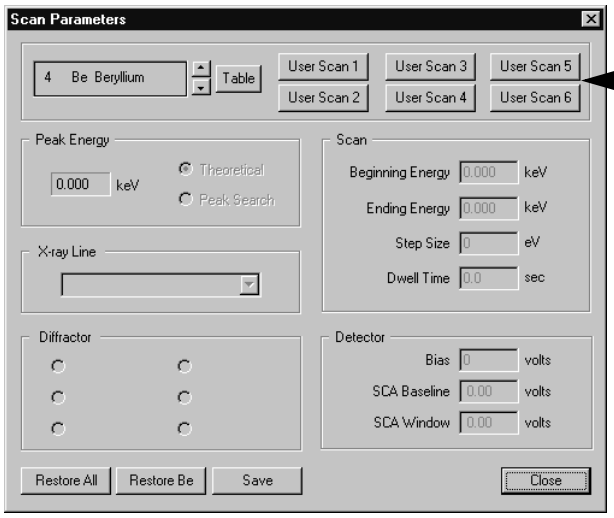
Up to 6 acquisition setup procedures can be stored using the User Scan buttons. Apply the saved setup by clicking on the User Scan buttons.

1. Define the element parameters to save.

   Set the parameters to associate with a User Scan button. For more information see Setting Up The Scan Parameters.

2. Save the setup.

   Click a **User Scan** button.



User Scan Buttons

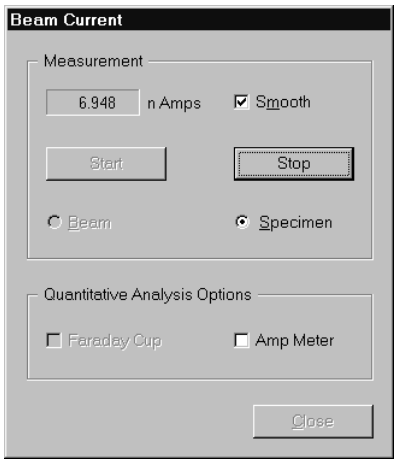
3. Enter a name for the parameters set.

   Type a name for the set (a maximum of nine character), and then click **OK**. The name displays on the button.

Beam Current

An accurate beam current must be obtained for Quant Analysis. Current varies for many reason at acquisition time. Not all systems have the optional equipment necessary to preform this procedure.

1. From the **Settings** menu, click **Beam Current**.



2. Select a reading location.

   The beam current reading is obtains from the Specimen or Beam.

   - Specimen – Reads at the stage level (use input 1 if you have the optional current meter equipment).
   - Beam – Reads at the beam current with an automatically inserted Faraday cup.

3. Select the Analysis Options.

   Determine the analysis option(s) to select from the following table.

Faraday	Amp Meter	Outcome
not selected	not selected	Manually insert the Faraday cup and Manually record the current.
not selected	Selected	Manually insert the Faraday cup and automatically measure the current (via input #1).
Selected	Selected	Automatically insert the faraday cup and read the current (via input #2).
Selected	not selected	Manually insert the Faraday cup and manually record the current.

4. Start the beam current reading.

   Click **Start**. The beam current displays and continuously updates. To average the reading click **Smooth**.

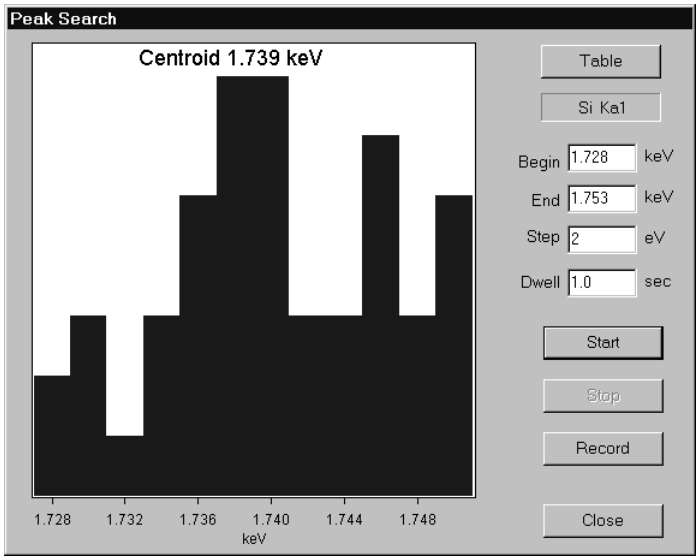
5. Stop the reading.

   Click **Stop**.

Peak Search

Peaks shift due to other element or chemical structure. A peak search locates a peaks centroid or locates a specific elements peak. The Peak Search is an automatic operation during Quantitative Analysis.

1. From the **Acquire** menu, click **Peak Search**.



2. Select an element.

   On the toolbar, click the **Table** button.

3. Begin the scan.

   On the toolbar, click the **Start** button.

   The computed centroid displays above the data.

4. Record the peak search centroid.

   Click **Record** to set the peak search energy value.

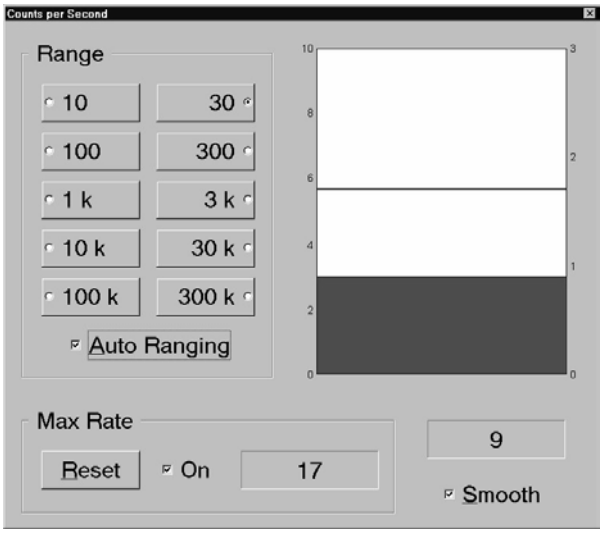
5. Exit Peak Search.

   Click **Close**.

Rate Meter

The rate meter displays the sum of all detected pulses at the current energy settings. Use the rate meter to determine if an element of interest is present.

1. From the **Count** menu, click **Rate Meter**.



   The count range on the left-side of the dialog box (10k, 100k, 1k, 10k, 100k) are graphed on the left y-axis.

   The count range on the right-side of the dialog box (30k, 300k, 3k, 30k, 300k) are graphed on the right y-axis.

2. Select a count range.

   Select an energy level or one of the following option.

   - Auto Range – A valid range is selected automatically.
   - Smooth – Averages all counts. Use this option if the counts are erratic.
   - On – The maximum rate (intensity) displays in the analog rate meter window and above the Reset button. This option is ideal for determining if any counts are available. Click Reset to clear the highest measure rate. This value is also reset when you select a different range or the range changes.

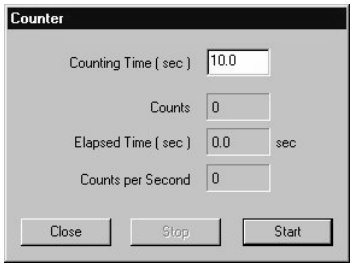
3. Exit Rate Meter.

   Click the Close button “X” in the upper-right corner of the Rate Meter dialog box.

Counter

The Counter displays the sum of all counts over a defined time and for a defined energy.

1. From the **Count** menu, click **Counter**.



2. Start the counter.

   Click **Start**, the counter displays the counts, elapsed time, and counts per second. Click **Stop** to interrupt the counter.

3. The counter information displays.

   During acquisition the number of counts measured, elapsed time (seconds), and count rate (counts per second) display.

4. Exit Counter.

   Click **Close**.

Acquiring a Spectrum

After completing the Scan Setup you are ready for spectral acquisition.

1. From the toolbar, click the **Start** button.

   A confirmation dialog box displays. Click **Yes**.

   The graphs x-axis represents the x-rays energy, in keV. Large peaks indicate the presence of elements in the sample.

   The graphs y-axis represents the x-ray counts at each energy level (peak intensity).

2. Stop the acquisition.

   Click the **Stop** button or wait until the acquisition ends automatically. IbeX/MAXray informs

you when the acquisition is finished. Click **OK** to continue.

You cannot resume an acquisition after clicking Stop.

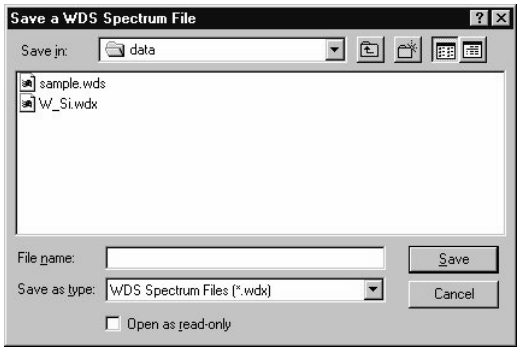
3. Display the spectrum with smooth peaks.

   Click the **Smooth** button.

Saving a Spectrum

Periodically save files by selecting the File menu, and the click Save. To save a file for the first time or to save in a new directory use the following procedure.

1. From the **File** menu, click **Save As**.



2. Enter a file name.

   Type a file name in the **File Name** text box field. The file extension WDX is automatically added to the file name.

3. Select a directory location.

   Click the **Save In** drop down list to select a file location. DO NOT store files in the directory C:\Noran\wds\data. To prevent deleting files it is a good practice to save files in a user defined directory.

4. Save the file.

   Click **OK**.

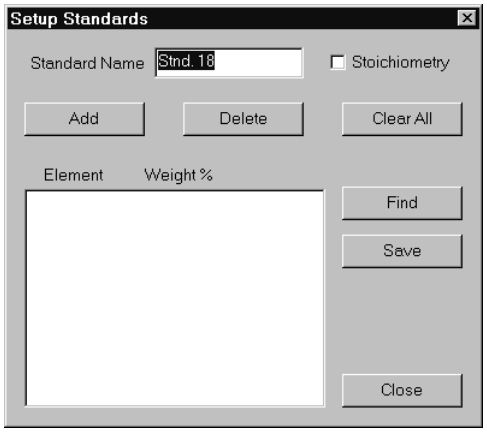
Quantitative Analysis

At least one standard must be defined for each element in the unknown sample. Quantitative analysis calculates the concentration of elements in the sample. The calculated concentrations are based on a net peak intensities of a standard and the unknown elements. A PROZA or ZAF matrix correction compensates for the mix of concentrations of elements.

Setup Standards

Define the elements that will be used in the standards file. The elements are defined by weight percent or the number of atoms (stoichiometry).

1. From the **Quant** menu, click **Setup Standards**.



2. Enter the Standards Name.

   Type a name in the **Standard Name** text box (maximum of ten characters).

   To locate a previously saved Standard file click **Find**. A list of Standards files displays. Click once on the file name to display, and then click **Select**.

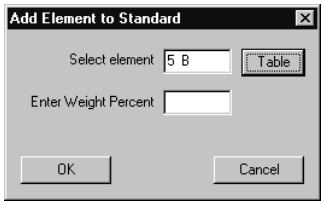
3. Select how to define elements.

   Elements are defined by a weight percent of the total standard, or by number of atoms in the standard. Select **Stoichometry** to define elements by atoms.

   When the Stoichiometry check box is not checked the elements are setup by number of atoms.

4. Define the elements in the standard.

- Click **Add**. The Add Element to Standard dialog box displays.



  Click **Table** to select an element, enter number of atoms or the weight percent, and then click **OK**.

- Delete – Remove an element from the standards setup list. Click once on an element, then click Delete.
- Clear All – Delete all the elements from the standard.

5. Save the standards file.

   Click **Save**.

6. Exit Setup Standards.

   Click **Close**.

Acquire Standards

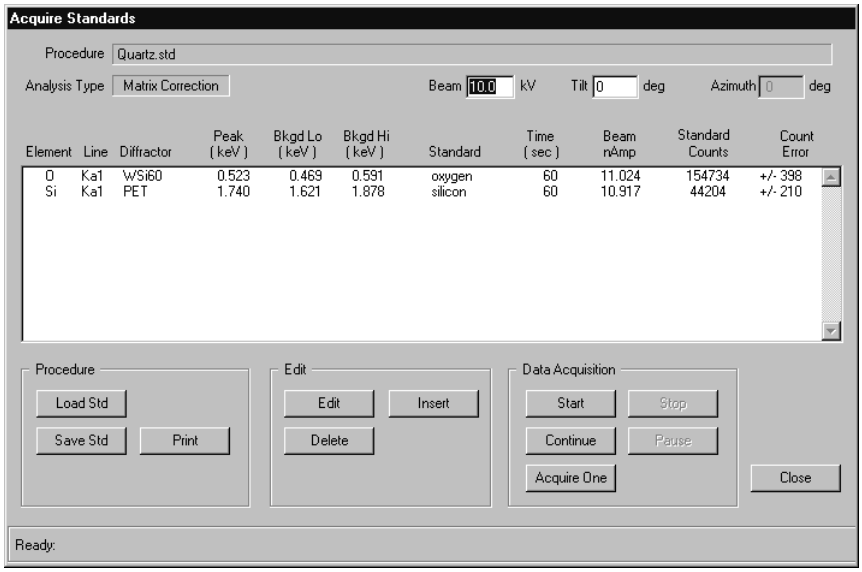
Acquire the counts for the selected elements. Before defining an element enter the composition of the element's (Setup Standards).

While acquiring standards it is assumed that the beam current is stable and the value is measurable. Background regions are defined on either side of the x-ray peak. The background energy is counted for 1/2 the peak time.

Standard Counts = Gross Peak Counts - Background Counts

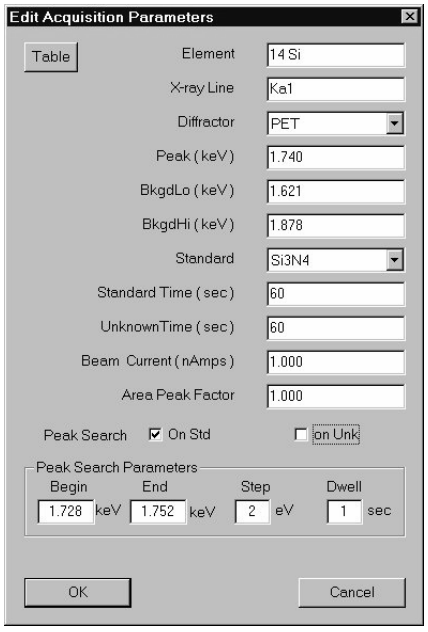
The standard counts and counting errors display when the count is finished. The status bar, at the bottom of the window, displays the progress of the count for an element.

1. From the **Quant** menu, click **Acquire Standards**.



2. Edit or Insert elements.

   Click **Insert** or **Edit**, and then click **Table** to select the element.



   The following fields display. Select the **Standard** (element) from the drop down list and

verify the remaining fields.

- X-ray Line – K, L, or M line.
- Diffractor – The diffractor.
- Peak – The peak centroid location.
- Bkgd 1 – The low background count location.
- Bkgd 2 –The high background count location.
- Standard – The standards (element) defined during element setup.
- Standard Time – The amount of time to acquire the Standard.
- Unknown Time – The amount of time to acquire the unknown element.
- Beam Current – The beam current (acquiring standards).
- Area Peak Factor – Adjust for changes in a peaks shape in carbon analysis.

3. Select the Peak Search Parameters.

   Both options can be selected. Any edits you make in this area display in the Peak Search dialog box. For more information see Peak Search.

   - Select **On Std** to preform a peak search on the element at the designated energy values.
   - Select **on Unk** to preform a peak search on the unknown element at the designated energy value.

4. Begin the acquisition.

   Select one of the following acquisitions buttons.

   - Click **Start** to acquire all elements, starting at the beginning of the list.
   - Click **Acquire One** to start and stop after acquiring the currently selected (highlighted) element.
   - Click **Continue** to acquire element in the list starting at the currently selected (highlighted) element and continue through the list in the order they appear.

   The following prompts display to verify set up information.

   - Acceleration Voltage.
   - Position beam on Standard.
   - Insert the Faraday Cup.

- Enter the Beam Current.
- Remove the Faraday Cup.

The acquisition begins. The status of the acquisition displays at the bottom of the IbeX/MAXray window. Acquisition stops automatically.

- Click **Pause** to temporarily stop the acquisition. Click **Continue** to start the acquisition where it was stopped.
- Click **Stop** to end the acquisition prior the designated acquisition time.

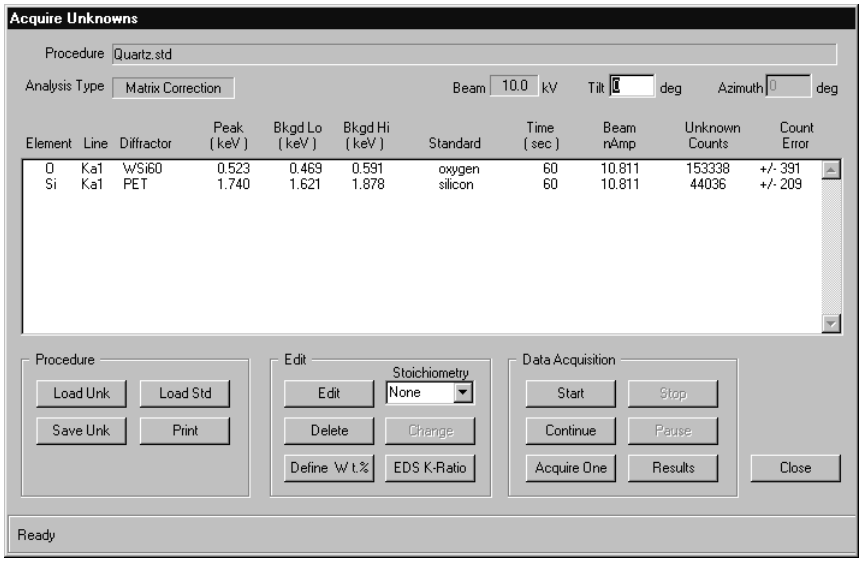
5. Save the standards file.
   - Click **Save Std**. Enter the standards file name, and then click **OK**. Standard files use the file extension std.
   - Click **Load Std** to re-acquire a previously saved standards file.
   - Click **Print** to print the currently displayed element information.

Acquire Unknowns

Acquire Unknown counts in the sample for the elements defined in Acquire Standards.

To obtain accurate results it is assumed during the quantitative calculation that all elements in the sample have been included, the total concentration is close to 100%. If some elements have known weight percent concentrations enter these values as fixed concentrations, for the quantitative result calculation and omit counting them. It is possible to calculate the weight percent of one element of the sample by difference from 100% rather than performing a count for the element. It is also possible to calculate the weight percentage of one of the five elements B, C, N, O, and F by stoichiometry. In this case define a chemical formula for each element in the acquisition list to provide the necessary stoichiometric relationships.

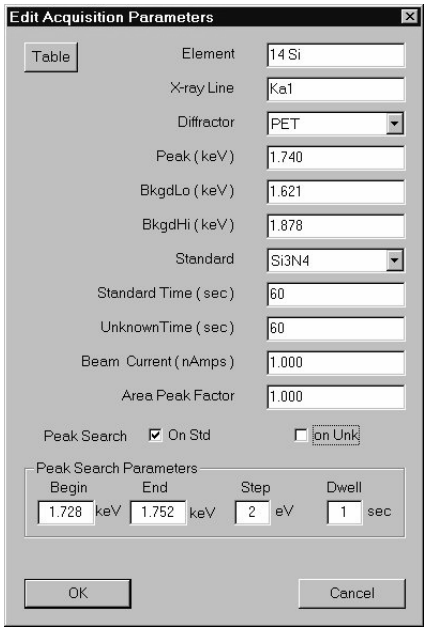
1. From the **Quant** menu, click **Acquire Unknowns** .



- If analyzing a set of elements for the first time, click **Load Unk**.
- Edit an element by clicking once on the element to modify, and then click **Edit**.
- Delete an element by clicking once on the element to remove, and then click **Delete**
- Modify the Weight percent by clicking once on the element to modify, and then click **Define Wt%**
- Enter a K-Ratio by clicking once on the element to modify, and then click **EDS K-Ratio**.
- Modify the Stoichiometry by selecting from the Stoichiometry drop down list, and then click **Change**.

2. Edit elements.

   Click **Edit**, and then click **Table** to select the element.



   The following fields display. Select the **Standard** (element) from the drop down list and verify the remaining fields.

   - X-ray Line – K, L, or M line.
   - Diffractor – The diffractor.
   - Peak – The peak centroid location.
   - Bkgd 1 – The low background count location.
   - Bkgd 2 –The high background count location.
   - Standard – The standards (element) defined during element setup.
   - Standard Time – The amount of time to acquire the Standard.
   - Unknown Time – The amount of time to acquire the unknown element.
   - Beam Current – The beam current (acquiring standards).
   - Area Peak Factor – Adjust for changes in a peaks shape in carbon analysis.

3. Select the Peak Search Parameters.

   Both options can be selected. Any edits you make in this area display in the Peak Search

dialog box. For more information see Peak Search.

- Select **On Std** to preform a peak search on the element at the designated energy values.
- Select **on Unk** to preform a peak search on the unknown element at the designated energy value.

4. Begin acquiring unknowns elements.

   Click **Start** to acquire the unknowns elements or click **Acquire One** to acquire data for the currently selected element only. The following prompts display to verify set up information.

   - Acceleration Voltage.
   - Position beam on Standard.
   - Insert the Faraday Cup.
   - Enter the Beam Current.
   - Remove the Faraday Cup.

   The acquisition begins. The status of the acquisition displays at the bottom of the IbeX/MAXray window. The Acquisition stops automatically.

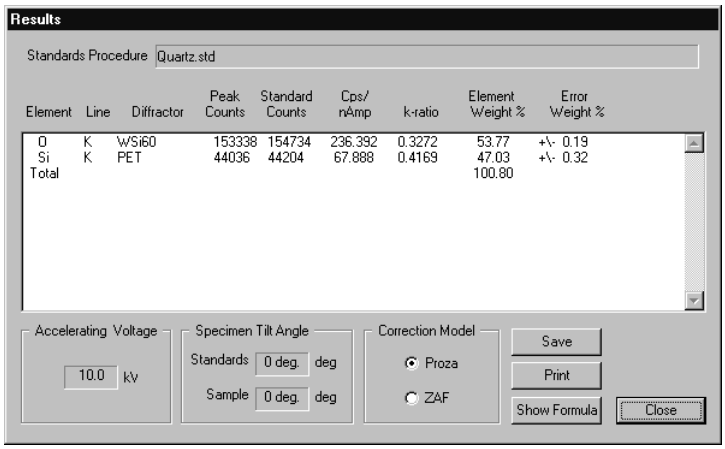
   - Click **Pause** to temporarily stop the acquisition. Click **Continue** to start the acquisition where it was stopped.
   - Click **Stop** to end the acquisition prior the designated acquisition time.

5. Save the acquisition.
   - Click Results to view the acquired information. For more information see Results.
   - Click **Save Unk**. Enter a file name, and then click **OK**.
   - Click **Print** to print the currently displayed element information.
   - Click **Close** to exit Acquire Unknowns.

Results

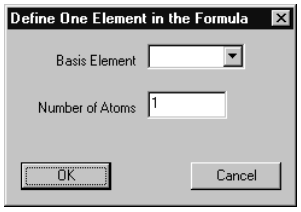
Select the matrix correction method for calculating each elements weight percentages in the sample.

1. From the **Quant** menu, click **Results**.



2. Apply a matrix Correction Mode.
   - Proza – A PRZ correction routine modified by Thermo Electron.
   - ZAF – Account for Atomic number (Z), Absorption (A), and Fluorescence (F).
3. View or change the Stoichiometric formula.

   Click **Show Formula**.



   Select an element from the **Basis Element** drop down list. Change the number of atoms.
   - Click **OK** to save the changes and exit.
   - Click **Cancel** to exit without saving changes.
4. Save the results file.

   The atomic percent for the defined element displays in the result window and the calculated atomic percent for the remaining unknown elements. Click **Save**, type the results file name, the file extension (rlt) is automatically added.

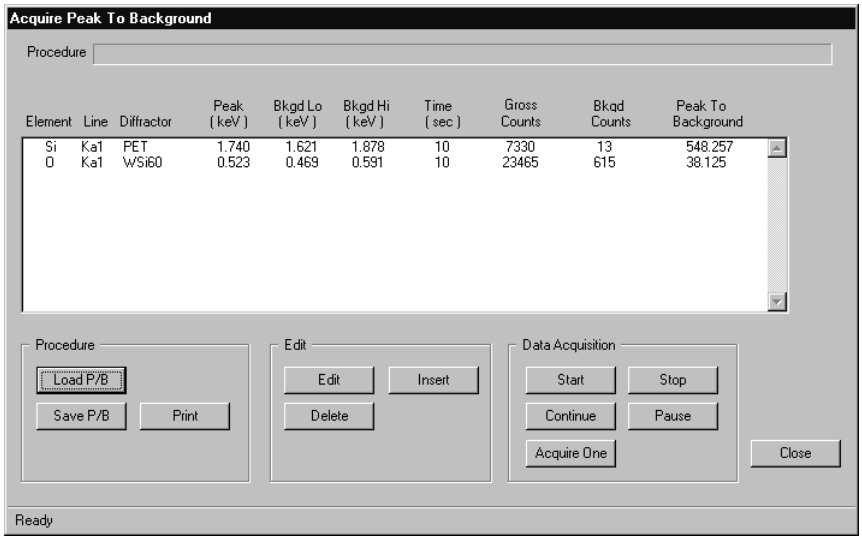
5. Exit Results.

   Click **Close**.

Acquire Peak to Background

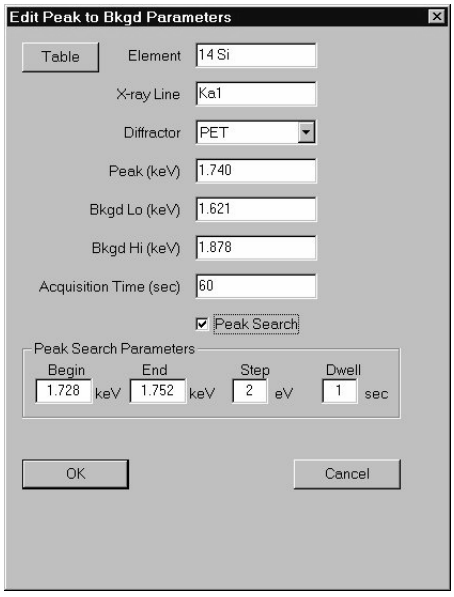
The Peak to Background acquisition determines if there is a detectable and quantifiable peak.

1. From the **Quant** menu, click **Acquire Peak to Background**.



2. Insert elements.

   Click **Insert**, and then click **Table** to select an element.



   Select an element by clicking the **Table** button. The following fields display. Verify and change information if needed.

   - X-ray Line – K, L, or M line.
   - Diffractor – The diffractor.
   - Peak – The peak centroid location.
   - Bkgd Lo – The location of the low energy background count.
   - Bkgd Hi – The location of the high energy background count.
   - Acquisition Time – The amount of time to obtain the peak centroid counts.
   - Peak Search – Select this check box to preform a peak search.

3. Select the Peak Search Parameters.

   Both options can be selected. Any edits you make in this area display in the Peak Search dialog box. For more information see Peak Search.

   - Select **On Std** to preform a peak search on the element at the designated energy values.
   - Select **on Unk** to preform a peak search on the unknown element at the designated

energy value.

4. Begin the acquisition.

   Click **Start** to acquire all elements. The following prompts display to verify set up information.

   - Acceleration Voltage.
   - Position beam on Standard.
   - Insert the Faraday Cup.
   - Enter the Beam Current.
   - Remove the Faraday Cup.

   The acquisition begins. The status of the acquisition displays at the bottom of the IbeX/MAXray window. The acquisition stops automatically.

   - Click **Pause** to temporarily stop the acquisition.
   - Click **Start** to acquire all elements, starting at the beginning of the list.
   - Click **Acquire One** to start and stop after acquiring the currently selected (highlighted) element.
   - Click **Continue** to acquire element in the list starting at the currently selected (highlighted) element and continue through the list in the order they appear.
   - Click **Stop** to end the acquisition prior to the designated acquisition time.

5. Save the Peak to Background file.
   - Click **Save P/B**. Enter the file name, and then click **OK**.
   - Click **Load P/B** to re-acquire a previously saved file.
   - Click **Print** to print the currently displayed element information.

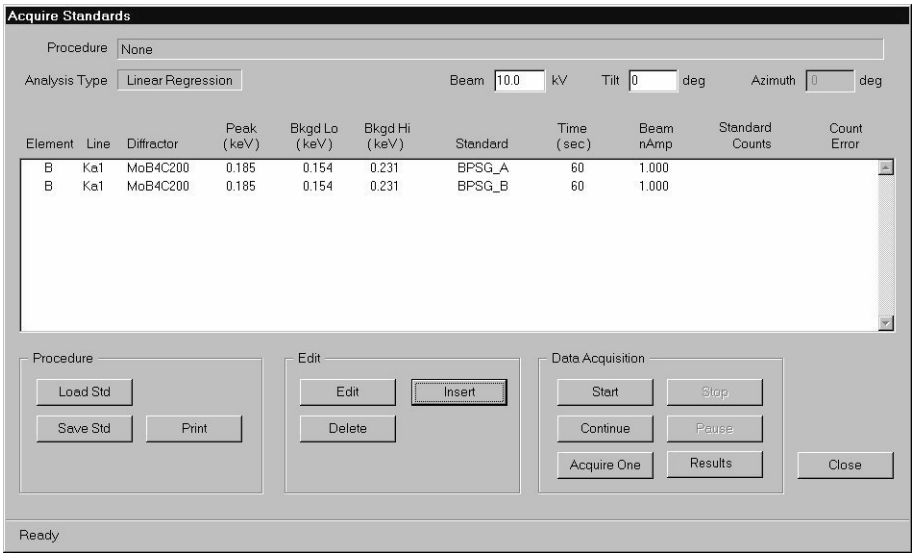
Matrix Correction and Linear Regression

Matrix correction is used during analysis except when the same element is used 2 times in an analysis. The Analysis type automatically changes to Linear Regression.

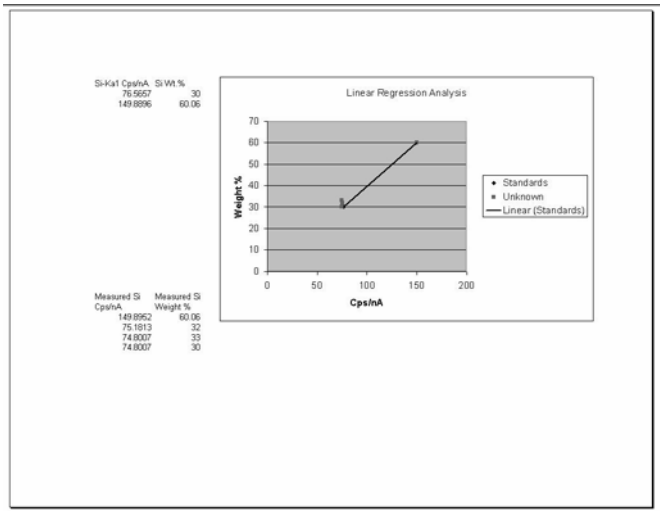
Follow the steps below for a linear regression.

1. Define 2 standards using the same elements but different concentrations.

2. Start an acquisition by loading the same element and use the 2 standards defined in step 1. the example below shows the same element using the 2 different standards.



3. After acquiring click **Results**. Microsoft Excel opens. To confirm that you want macros enables click **Enable Macros**. An new Microsoft Excel spreadsheet displays with a button labeled "Read Data". Click **Read Data** to display the linear regression graph and data.



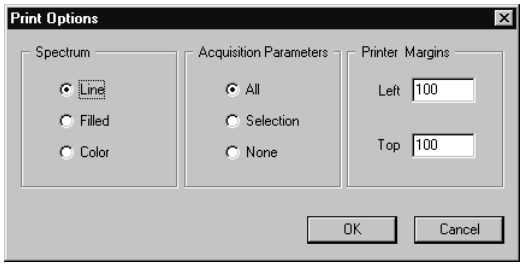
Printing Reports

Print the spectrum and associated acquisition information in a formatted report. For best results set your prints resolution to 300 dpi (the procedure for setting your printers resolution is described below).

1. Display the spectrum.

   Verify the current display contains the labels and colors you want on the report. For more information see Displaying a Spectrum.

2. From the **File** menu, click **Print Options**.



3. Select print options.

   Select the spectrum parameters.

   - Line – Print the spectrum as an outline.
   - Filled – Print the spectrum as a histogram.
   - Color – Print the spectrum in color (histogram).

   Select the acquisition parameters.

   - All – Print all acquisition parameters.
   - Selection – Print selected acquisition parameters (selections are made later in this procedure).
   - None – Print the spectrum only.

4. Enter the Left and Top margins, in pixel.

   100 pixels is approximately 1 inch.

5. Save the Print Options.

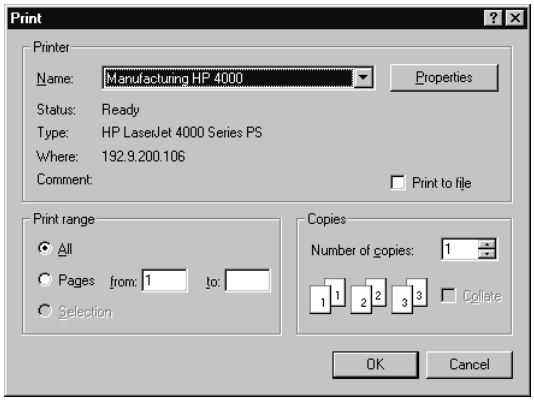
   - Click **OK** to save the changes and exit.
   - Click **Cancel** to exit without saving the changes.

6. Verify the Acquisition Information.

From the **Edit** menu, click **Acquisition Information**. The selected check boxes determine the report information that prints. Verify the information and then click **Close** to apply the changes.

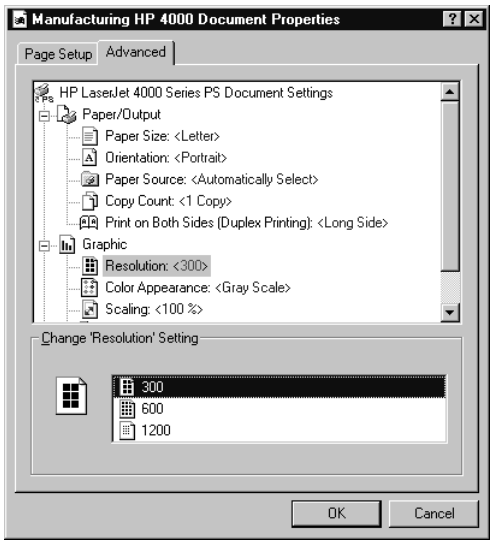
7. Print the report.

   From the **File** menu, click **Print**. The print dialog box displays. Select a printer from the **Name** drop down list.



8. Change the printer resolution.

   Click the **Properties** button. The selected printers properties dialog box displays. Select the **Advanced** tab.



   Under Graphics, click once on **Resolution**. The resolution options display at the bottom of the dialog box (change resolution settings). Click once on **300**, and then click **OK**.

9. Print the report.

   Click **OK**. The spectrum prints.

Procedure for Combined EDS-WDS Analysis

The optional WDS interface equipment is required to preform the following analysis.

Qualitative Analysis

1. In the VANTAGE EDS spectral display define a region of interest (ROI) covering the energy range desired for a WDS scan.
2. Place the cursor within the defined ROI.
3. Click the WDS icon on the spectral display QuickClick bar to start the wavelength scan.
4. When the scan is complete the WDS scan will be placed in a spectral area on the VANTAGE system and the EDS spectrum will be overlapped with th e WDS scan in the spectral display window.

Quantitative Analysis

Setting Up Standards

Standards must be used to obtain k-ratios for all elements whose weight concentrations are to be measured in the sample.

1. Count standards for the WDS elements on the MAXray or IbeX spectrometer at the same conditions as will be used for the sample and save the standards file in the directory named wds_standards.
2. Count standards for the EDS elements on the VANTAGE system. Make sure the beam current is correct in the VANTAGE column tool when the EDS acquisitions are started. Store references obtained from the EDS spectra by using the References option under the Tools menu on the spectral display window.

Sample Count

1. Define the elements to be analyzed with EDS and WDS in the quantitative periodic table on the VANTAGE system. Select Mixed or User for the type of references in the periodic table Quant Parameters window. Make sure the correct References Database is selected in the window.
2. In the SPA dialog menu select Acquire/Options/Concurrent_WDS and define whether the count of the WDS is to be conducted before, during, or after the EDS count.

3. Make sure the beam current and keV are correct in the VANTAGE column tool and start the combined EDS/WDS acquisition by clicking the start icon in the spectral display QuickClick bar. The beam current for the WDS count will be obtained from the BANTAGE column tool. The files in the wds_standards directory will be scanned for the fie that has the correct keV and correct WDS elements for the count. If more than one file satisfies these criteria, the operator will be prompted to select the correct file.
4. When the count is complete the Quantitative Analysis icon on the QuickClick bar of the spectral display window can be used to obtain the quantitative results for the sample.

Exiting IbeX/MAXray

To exit the IbeX/MAXray program use one of the following procedures.

- From the **File** menu, click **Exit**.
- Hold down Alt on the keyboard, and then press F4.
- Click the Close button (X) in the top right corner of the main window.

3 – Menu Reference

Each menu contains options for preforming operations in the software. The following is a description of each menu and the options in the menu.

File Menu

Save, load, and print from the File menu.

Open

View or modify a previously saved file.

Open Overlay

Display additional spectra files in the same display. Up to two additional files can display by selecting Overlay 1, then Overlay 2. For more information see Changing Display Colors.

Overlay 1

Select the first spectral file to display.

Overlay 2

Select the second spectral file to display.

Save

Periodically save the current file to a previously defined location.

Save As

Save a file for the first time or save to a new directory (location).

Open EMSA

EMSA is a standardized file format used to transfer data files from one x-ray analyzer to another. Use the Open EMSA option to load a spectrum that was saved using the EMSA format.

Save as EMSA

Save a spectrum file in the EMSA format.

Print

Print the current spectral file using the defined print option

Print Options

Define or modify the information to print on the report. For more information see Acquisition Information.

Print Preview

Display the defined report prior to printing.

Exit

Close the IbeX/MAXray program.

Edit Menu

Edit and view the acquisition information and scan parameters.

Acquisition Information

Specify the Information to record during acquisition.

Scan Parameters

Edit the data acquisition conditions.

Acquire Menu

Collect the spectral data from the spectrometer.

Element Scan

Quickly scans an element or defined energy range.

Setup Scan

Set or view the scan parameter.

Peak Search

Locate the centroid of a peak.

Start Scan

Begin the scan procedure. Scan Setup must be completed prior to starting the scan.

Stop Scan

Stop a scan already in progress.

Pause Scan

Pause a scan already in progress. For example, pause a long scan to check the beam position (spot mode). Click Continue to resume the scan.

Count Menu

View the rate meter and x-ray counts.

Rate Meter

Display an analog rate meter.

Counter

During acquisition, display the total number of counts, elapsed time, and count rate.

Settings Menu

Modify and view information about diffractors or position the spectrometer.

Configuration

Display the available diffractors and energy ranges.

Position Spectrometer

Position the diffractor or detector to the correct Bragg angle.

Bias Scan

Determine the detectors bias voltage to fine tune the detector voltage. This option is used with the SCA Scan.

SCA Scan

Determine the x-ray lines single channel analyzer voltages, fine tune the detector bias voltage (found with the bias scan function). This option is used with teh Bias Scan.

Beam Current

Measure the beam current or the specimen current.

View Menu

Modify the Labels, cursor display, and tool bars features in the window.

Cursor

Display or remove the energy cursor.

Peak Labels

Display or remove peak labels.

KLM Markers

Display or remove the markers on the spectrum.

Peak Information

Extract information from a peak.

Status Bar

Display or remove the status bar, located below the spectral display.

Toolbar

Display or remove the toolbar, located above the spectral display.

Tool Tips

Display or remove the tool tips feature.

Vertical Arrows

Display or remove the vertical scroll buttons, located on the left side of the display. These arrows are on a movable tool bar. Click and drag on the space above or below the arrows to move the toolbar.

Horizontal Arrows

Display or remove the horizontal scroll buttons, located on the bottom of the display. These arrows are on a movable toolbar. Click and drag on the space to the left or right of the arrows to move the toolbar.

Overlay

Display or remove spectra overlays.

Overlay 1

Display or remove overlay 1.

Overlay 2

Display or remove overlay 2.

Options Menu

Preform the spectrum analysis and modify display features.

Smooth Spectrum

Display smooth or raw spectral data.

Scale Spectrum

Scale the spectrum to fit the display window.

Scale Overlay

Scale the overlay spectrum to the foreground spectrum, using the intensity data surrounding the energy cursor.

Offset Overlay

Display or remove an offset view of the overlays.

Identify Peaks

Perform a peak search and label the spectrum.

Peak Hints

Display the Peak Hints dialog box.

Clear Labels

Display or remove peak labels from memory.

Select Labels

Define the element labels.

Modify Display

Modify display information such as raw or smooth data, black/white or color, line or histogram, and thick or thin font.

Change Colors

Change the display colors, select a preset color scheme, or modify the systems default color scheme. Options include spectrum, background, overlay1, overlay 2, border, surround, peak labels, numbers, KLM markers, and axis labels.

Sound

Select the Sound option to turn on the computers audio hardware. A check mark displays when this option is turned on. To turn off the sounds select this menu option to remove the check mark.

Quant Menu

Perform the sample analysis. Create, acquire, and display standards.

Setup Standards

Measure the elements weight concentration in the sample, delete standards, or change the standards composition values. At least one standard must be defined for each element.

Acquire Standards

Define the elements weight concentrations in the sample, or count the standards for these elements. Enter the elements composition (Edit Standards) prior to selecting this option.

Acquire Unknowns

Count the defined elements in the sample.

Acquire Peak to Background

The peak to background option identifies the absents or presents of an element. This indication reflects the relative concentration of that element compared to the background.

Results

Select the matrix correction method. This method is used to calculate each elements weight percentage.

Service Menu

Most options on the Service menu are used by Thermo Electron service engineer and are password protected.

Initialize Motors

Reset the detector and diffractors starting position. This operation must be preformed whenever the system is restarted.

Password

Password provides access to the remaining Service menu options. Contact your service representative for more information.

Help Menu

Access information about the IbeX/MAXray program from the Help menu.

Introduction

General information on the IbeX/MAXray program.

Navigating

Information on how to navigate in the IbeX/MAXray program.

How To

Information on how to preform basic operations in the IbeX/MAXray program.

Menu Commands

Information on commands associates with each menu item.

About

Information on the IbeX/MAXray program version and copyright.

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